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THE R&D TAX CREDIT: AN EVALUATION OF EVIDENCE ON ITS EFFECTIVENESS

A STAFF STUDY

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LETTER OF TRANSMITTAL

JULY 29, 1985.

Hon. DAVID R. OBEY,
Chairman, Joint Economic Committee,
Congress of the United States, Washington, DC.

DEAR MR. CHAIRMAN: I am pleased to transmit a study on "The R&D Tax Credit: An Evaluation of Evidence on Its Effectiveness." The author is Dr. Kenneth M. Brown, staff economist.

The study reviews the available statistical evidence on the effectiveness of the tax credit for research and development expenditures, a provision that took effect in mid-1981. It also examines how the tax credit's formula would be likely to affect a company's decision on whether to invest more funds in R&D. All of these factors are examined in a cost-effectiveness framework, the object being to see whether the tax revenue foregone by the Treasury is money well spent. The author concludes that the tax credit is an effective way to encourage research and development in the private sector.

Sincerely,

JAMES ABDNOR,
Vice Chairman, Joint Economic Committee.

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THE R&D TAX CREDIT: AN EVALUATION OF EVIDENCE ON ITS EFFECTIVENESS

By Kenneth M. Brown*

SUMMARY

The tax credit for research and development (R&D) went into effect in July 1981. It gives a tax credit equal to 25 percent of a firm's increase in spending on qualified R&D. As this credit is scheduled to expire at the end of 1985, the question arises as to how effective the credit has been in terms of encouraging additional R&D funding. The credit is estimated to cost about $1.6 billion in foregone Treasury revenues during fiscal year 1985.

The evidence on the effectiveness of the credit, while somewhat ambiguous and incomplete, appears to show that company funds for R&D are higher than they would have been in the absence of the credit. Aggregate data and industry data are consistent with the credit's having stimulated fairly significant increases in R&D. Data from tax returns, however, are inconclusive. Taken at face value, tax data fail to demonstrate that the credit was (or was not) effective. Moreover, available tax data cover only the early years of the credit and are necessarily inconclusive given the long lead times in initiating R&D projects.

Despite all of this inconclusiveness over the *past* effectiveness, it is quite likely that a permanent credit would in the *future* be adequately cost effective, as firms adapt their long-term planning to the credit's availability.

Revisions to the formula by which the credit is calculated could make it more effective in stimulating R&D. Similarly, since the temporary nature of the credit has detracted from its effectiveness, a permanent credit is preferable to a mere extension.

*Staff economist, Joint Economic Committee.

I. INTRODUCTION

In 1981, Congress enacted a tax credit for increases in spending on research and development (R&D). This credit, a provision of the Economic Recovery Tax Act, is scheduled to expire on December 31, 1985. The time is nearing when Congress will have to decide whether to extend the credit, change its provisions, or let it expire. This study is meant to examine the evidence on whether the credit has justified its cost and whether it is likely to be worthwhile in the future.

By now, it is generally accepted that private research and development is extremely important to technological progress which, in turn, is probably the most important single factor to the Nation's economic growth. Less general agreement is evident on whether the Federal Government should offer financial support or tax benefits to encourage corporate R&D, although the passage of the R&D tax credit, along with a great variety of other forms of Federal support to the scientific and research complex, seems to indicate that such support is widespread. All of the leading industrial countries give support to corporate research, and several of these countries offer some sort of specific tax benefits for R&D spending.

The real issue—made all the more relevant by the current need for budget stringency—is whether the tax credit is a cost-effective means of encouraging R&D. The evidence is not straightforward. The related issue is, whatever the effectiveness of the existing credit, whether the credit's formula could be revised to be made more effective. These are the two topics on which this study seeks to evaluate the available evidence.

The President's tax proposals of May 1985 call for an extension of the credit until December 31, 1988. The question arises as to whether this major tax program will be enacted before the December 31, 1985, expiration of the R&D tax credit. A further question is whether making the credit permanent is preferable to a 3-year extension.

II. GOVERNMENTAL SUPPORT FOR RESEARCH AND DEVELOPMENT

Several studies of the tax credit for R&D have already been written, and most of them go to some lengths to establish the importance of technological progress, and hence R&D, to the economy. Since so much has already been written, and because the importance of technological change is not disputed by any knowledgeable writer on the subject, this study will treat the subject very briefly, pausing only on the few issues of any controversy.

Technology and Productivity Improvement

One of the most notable early empirical studies of the importance of technological change was published by Robert Solow in 1957. Using very aggregated data, he estimated that roughly 80 percent of the growth in output per worker in the United States during the period 1909–49, was the result of technical change.[1] Later research by a host of economists refined and extended this analysis. While the estimates of the portion of growth ascribed to technical change varied, without exception, these studies found that technological change is an important source of economic growth.

The most recent study (work in progress by Denison (1984)) finds that two-thirds to 80 percent of the productivity growth achieved between 1929 and 1982 was directly or indirectly attributable to technological advance.

Moreover, technological change is quite important to the competitive position of the United States in world markets. By and large, our high-technology industries are much more active exporters than our basic manufacturing industries. The United States apparently has a comparative advantage in goods which are the result of recent R&D and which require highly educated labor in their design and production. (See CBO (1984), pp. 37–44, and Baily (1985), pp. 24–37.)

Research and Technological Change

The link between research and technological change would seem equally strong. Do not all innovations originate with some form of research and experimentation, whether it be a lone inventor or a mammoth laboratory at Du Pont or IBM? Clearly the link is there, but it has been difficult for economists to measure this relationship with precision. That is, economists would like to be able to state the rate of return to investment in research, and indeed several

[1] Or more precisely, the result of all factors other than the increase in capital per worker.

studies have shown this rate of return to be quite high [2] although, of course, quite variable from case to case.[3]

A Role for Government?

Despite the clear linkage between R&D and innovation, and between innovation and economic growth, more is needed to establish a governmental role in supporting private R&D. (The Government funds an enormous amount of R&D for its own purposes—mainly defense—with fiscal year 1986 outlays planned to total $53 billion.) The economic arguments for such support stem from the observation that the total rate of return on private R&D greatly exceeds the private rate of return. That is, private R&D gives rise to benefits to society at large well in excess of the profits it generates for the company that funds the R&D. Such "spillover benefits" or "neighborhood effects" thereby put R&D into the class of goods such as public health and sanitation, education, clean air and water, and defense that fall into the sphere of governmental responsibility.[4]

These qualitative arguments for a governmental role give very little guidance as to how large that role should be. Ideally, one would advise expanding private R&D to the point where the total (public and private) rate of return fell to equality with other rates of return in the economy. Unfortunately, existing empirical studies lack this degree of precision, owing mainly to limited availability of data. Moreover, future results from R&D are extremely uncertain; we don't know whether the rate of return will be higher or lower than in the past.

Nevertheless, the government of every major industrial nation spends considerable sums on R&D and gives very significant support to private R&D. (See Baily (1985), pp. 38–42.)

How well do we stack up against other nations? Despite the importance of innovation to economic performance, and despite the evidence that innovation is at the root of this nation's comparative advantage in international trade, we may be neglecting private R&D. One indication of R&D effort is the ratio of R&D spending to gross national product (GNP). By this measure, we are on about the same level as Japan and West Germany and ahead of France. But we spend a much larger portion of our R&D funds on military research, which provides only limited benefits to the rest of the economy. In civilian R&D, as a percent of GNP, we trail West Germany and Japan by significant margins.

Types of Governmental Support

If it is conceded that the Government has some role in the support of private R&D, the question is naturally raised as to the means by which this support should be given. The major alternatives are (1) for the Government to perform the research in its own laboratories, (2) to give direct subsidies to private research projects

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[2] See Mansfield et al. (1977). This study cites a median social rate of return of 56 percent for 17 innovations studied.

[3] For a review of these studies, see CBO, 1984, pp. 28–31.

[4] Gravelle (1985) also lists "risk" and "asymmetric information" as possible justifications for governmental support of private R&D.

approved by the Government, and (3) to adjust the Tax Code in a way favorable to the performance of private R&D.

There is no pat answer to this question. In general, there is some consensus that when the Government knows precisely what it is trying to accomplish, and particularly when the project is very large, then the Government should perform the research itself. Example: the development of the first atomic bomb. Further, when the objective is to support basic research, far removed from industrial development of commercial products, then direct grants to universities and research foundations are appropriate. But there is also a class of research that seems best left as much as possible in the hands of the private sector. This is the research on and development of commercial products that will be exploited by private firms with no direct interest by the Government. For example, it would appear to be highly inappropriate for the Government to determine that supercomputers were a promising endeavor and then give funds to a select group of companies. The selection process would never be perfect and might become fraught with politics, inefficiency, and favoritism. Limiting the funds to a few favored firms might fatally disadvantage small, innovative companies with great ideas but inferior skills in grantsmanship.

Indeed, many of today's most successful high-tech products were developed by innovative startup companies, e.g., the Apple computer, and practically all of the software for the Apple and other personal computers.

On the other hand, the private businessman—with his own money at risk—has a strong incentive to make sure that his decisions are based upon sound information. Even if he receives a tax credit (which is arguably his own money anyway), he still is likely to be more careful and more attuned to profit potentials than the governmental administration might be.

Conclusion

In principle, there would seem to be a role for governmental support for private R&D. But like all government spending or tax relief, such support should be subject to scrutiny to determine whether it meets criteria of cost effectiveness. This is the most controversial step in the chain of reasoning needed to justify the existing tax credit for research and development, and it is the subject of the remainder of this study.

III. HOW THE CREDIT WORKS

The tax credit for R&D allows firms to deduct, from their tax liability, an amount equal to 25 percent of their qualified R&D expenditures in excess of a base-period amount. The credit went into effect on July 1, 1981. For 1983 and later years, the base is the average of eligible expenditures for the previous 3 years. In 1981, only second-half spending was eligible, and the base was defined as half of R&D spending the previous year. In 1982, the base was the firm's spending during the 2 previous years.

Activities eligible for the credit are R&D "in the experimental or laboratory sense" that is conducted in "carrying on" the firm's existing trade or business. Eligible expenditures include researchers' wages, research supplies, rent for equipment, and 65 percent of all contract research. Direct purchase of R&D plant and equipment do not qualify for the R&D credit, but are eligible for an investment tax credit (6 percent on equipment, 10 percent on structures) and for accelerated depreciation.

Base period expenditures may not be calculated as less than 50 percent of qualified research expenditures for the current year. In other words, if a firm's spending for the last 3 years averaged $100, and in the fourth year was $250, the base would have to be figured as $125, and the firm would get a credit for 25 percent of the difference between $250 and $125, or $31.25. For the amount of R&D over twice the base of $100, the firm got only a 12.5 percent credit.

If the amount of credit exceeds the taxpayer's tax liability (reduced by certain other nonrefundable credits), the excess amount of credit can be carried back 3 years and carried forward 15 years.

The credit is scheduled to expire December 31, 1986.

A Feature of the "Shifting Base"

The reason for this incremental form was to increase the incentive for R&D per dollar of lost tax revenue. If a 25 percent tax credit were offered for *all* of a taxpayer's R&D, the revenue loss would be far greater. But by offering the credit only on the increase in R&D a similar incentive is given at much less cost to the Treasury in lost tax revenue. As we shall see in a later section, this feature has caused considerable controversy as to the effectiveness of the credit. For the present, it must be pointed out that two opposing results occur when the taxpayer increases his R&D spending by $100:

He receives a tax credit of $25 for the current year.

His "base" in each of the next 3 years increases by $33.33. (This is because the extra $100 is added to a 3-year total which is then averaged by dividing it by 3.) This can reduce future credits by as much as $8.33 ($33.33 x 25 percent) in each of these 3 years, or $25 altogether.

So an increase in R&D spending this year earns a credit, but it also reduces—by an equal amount—any credit for which the taxpayer is eligible in the 3 succeeding years.

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IV. EVIDENCE ON WHETHER THE CREDIT ENCOURAGED SPENDING ON RESEARCH AND DEVELOPMENT

Assuming that research and development are, in principal, worthy of governmental support, the question becomes how best to provide this support. Using tax incentives has the advantage of being market oriented, leaving decisions to be made in the private sector. But will tax incentives actually stimulate spending on R&D? As indicated earlier, the tax credit costs well over $1 billion annually in revenues foregone by the Treasury. What have been the effects of this tax expenditure? Do these effects justify the cost?

To start with, let us try to determine whether the credit actually stimulated R&D, leaving to the next chapter the question of whether the stimulus was worth its cost. To answer this question, several different analyses and data series will be examined. It should be recognized at the outset, however, that the available evidence is ambiguous, and even after all of the evidence is assembled and weighed there will still be room for legitimate differences of opinion.

Evidence From Aggregate Data

Company spending on research and development has shown reasonably steady growth in the long term, with the exception of a period in the 1970's when it slumped badly. This slump provided much of the impetus for Congress to enact the tax credit for R&D. In this section we will examine the behavior of company spending on R&D, expressed in constant dollars (using the GNP deflator), hoping to find evidence on whether the credit was effective.

Between 1957 and 1969, real R&D grew at a compound annual rate of 6.7 percent, much faster than GNP grew. Between 1969 and 1976, however, R&D growth sagged to 2.1 percent. In 3 of those years, company R&D spending declined. Since Federal spending *fell* during this period, after rapid growth in the 1960's, it was obvious that something had changed significantly in the Nation's allocation of resources to science and technology.

In the late 1970's, company R&D spending resumed its earlier growth path, with a 6.6 percent compound growth rate between 1976 and 1984. A real R&D boom got underway in 1979, with R&D growth averaging 7.3 percent between 1978 and 1982.

Figure 1 shows annual percent changes in real R&D, with the mid-period slump clearly visible. There appears to be a slight slowing of the growth after 1982. Figure 2 shows R&D as a ratio to GNP, thus giving an idea of the fraction of our annual product that is devoted to R&D. Here the surge continues through the present, suggesting that the slight slowing of R&D growth around 1982 was a result of the recession.

Do these data indicate whether the R&D credit contributed to the resurgence? Cursory inspection of figures 1 and 2 would imply that the R&D recovery was well underway before the tax credit went into effect. On the other hand, R&D spending remained strong during the 1982 recession, perhaps buoyed by the credit.

FIGURE 1

PERCENT CHANGE IN INDUSTRIAL R&D, 1972 DOLLARS

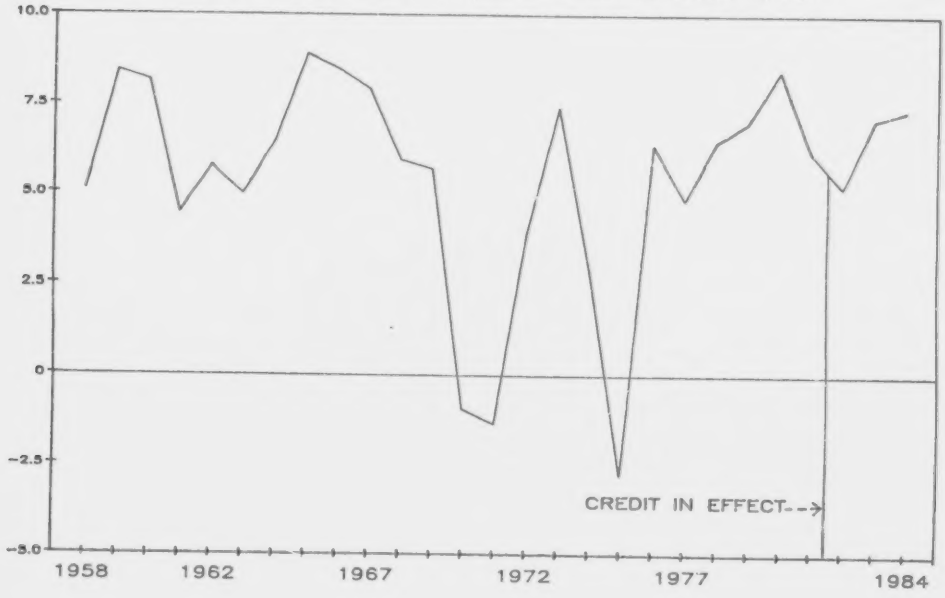
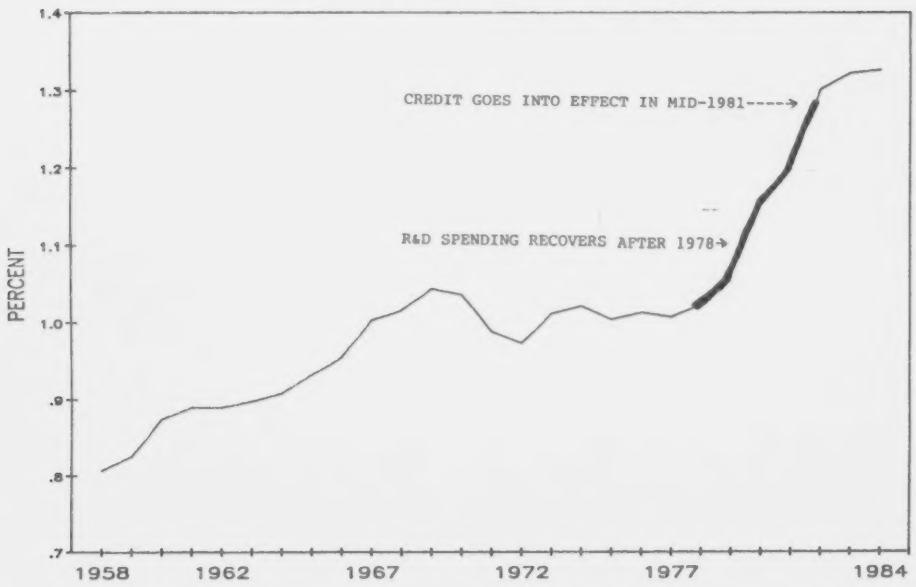


FIGURE 2
COMPANY FUNDS FOR R&D
AS A FRACTION OF GNP



Several regression equations were estimated and used to measure the credit's effect. Using 1957 to 1982 data, one equation related real R&D spending to the index of industrial production, with a close statistical fit. Then, using actual industrial production for 1981–84, the equation was used to forecast R&D spending. The forecasted values averaged $8 billion a year (current dollars) lower than the actual values, thereby implying an effect of the credit far higher than its most ardent supporters would assert.

A second equation was estimated, this time using data from 1957 through 1984 and with a "dummy variable" to represent the institution of the tax credit. This variable was highly significant and implied that the credit was responsible for an extra *$10* billion of R&D spending each year, nearly one-fourth of the total in 1984.

Clearly these estimates are too large to be taken at face value. Most likely, the equation is misspecified, meaning that some other factor (left out of the analysis) was really responsible for much of the boom. Or perhaps the slump of the 1970's was a temporary aberration that biased the coefficient of industrial production downward.

Nevertheless, while these results do not constitute proof, it can be said that they are consistent with the hypothesis that the tax credit stimulated R&D spending.

What Influences a Firm's R&D Spending?

Most analysts have viewed R&D spending as essentially similar to investment in plant and equipment, insofar as the firm's decisionmaking is concerned. In both cases, the firm spends money in the present in hopes of obtaining a positive return in the future.

The returns on R&D are generally more uncertain than those on ordinary investment, for that firm cannot know with any certitude what discoveries will come out of its laboratories and how much these discoveries will be worth in the market.

In analyzing the determinants of investment, the concept of the "user cost of capital" is central. The idea is that the demand for capital depends upon the cost of capital, which in turn depends upon the rate of interest, the market price of capital goods, and the after-tax return.

The tax credit is best understood as one of the factors affecting the effective cost to the firm of R&D. While there is some complication in calculating the exact effect of the credit (because of the effects on the base in future years, as mentioned in Chapter III), the credit acts to reduce the effective cost to a firm of carrying on research and, hence, increases the quantity of R&D demanded.

But *how much* additional R&D results from a dollar of tax credit? This is a standard empirical question in economics. It can be rephrased as "what is the price elasticity of demand for R&D?" Ideally, we would like to know that the price elasticity is, say, 0.7, which would mean that a 10 percent reduction in the price of R&D would result in a 7 percent increase in the quantity of R&D demanded by a firm. Unfortunately, reliable estimates of this elasticity, or responsiveness, are all but nonexistent in the economic literature.

A study frequently cited as Nadiri (1980), which estimated an elasticity of 0.3. But the data and the assumptions which Nadiri used (for lack of any better) reflect the weak empirical basis available for such analysis. He assumed that the price of R&D could be represented by the rental price of all capital goods, as no independent measure of the price of R&D was available. Since this study was done before the tax credit took effect, there was no way to observe a specific change in price, such as occurred when the tax credit went into effect.

L. Goldberg, in a 1979 memo, estimated a short-run elasticity of 0.33 and a long-run elasticity of 1.0.[1] The latter (higher) value indicates a more effective credit. But Goldberg concedes that his estimated relationship may be due to omitted factors.

Nadiri, in the National Science Foundation colloquium (1981), surveys the literature on this topic. He reports on several other studies, but none of them provide useful estimates of the elasticity of demand for R&D.

In sum, none of the analysis done prior to 1981 presents strong evidence either for or against the potential effectiveness of a tax credit for R&D. There simply are no good data on which to base such an analysis. Let us then move on to evidence relating to the tax credit itself. This will include (*a*) data on aggregate private R&D before and after the availability of the credit, (*b*) analysis of industry data on R&D, (*c*) surveys of firms that were eligible for the credit, and (*d*) analysis of tax returns of companies that claimed the credit.

[1] The Goldberg study, to which I have not had direct access, was cited by Nadiri in the National Science Foundation colloquium. The interpretation of Goldberg's findings is Nadiri's.

Industry Data and Analysis

Baily, Lawrence, and DRI, in their 1985 study prepared for the Coalition for the Advancement of Industrial Technology, take two approaches to the problem of estimating the impact of the tax credit.

Their first method is essentially a microeconomic version of the approach used in the previous section of this report. They compare actual 1982–83 R&D spending in R&D-intensive industries with values predicted by trend and cycle factors. Again, the idea is that if the actual values of R&D significantly exceed the predicted values, then this is evidence that the credit was effective in stimulating R&D spending. They found that in 9 of the 12 industries examined actual spending exceeded projected spending. (Interestingly, several of the basic industries—chemicals, steel, and nonferous metals—spent over 10 percent more than was projected based on trend and cyclical patterns. This suggests that the effect of the credit was not confined to the high-tech sector.)

The two industries that spent less than projected amounts on R&D were the automotive industry (which during 1982 and 1983 was struggling against a massive drop in demand for its product) and petroleum (which was suffering from a decline in demand and falling prices).

Taken together, the industry estimates indicate an increase in R&D spending of about 7 percent of the result of the credit. These results, like the aggregate figures presented earlier, are consistent with the hypothesis that the credit stimulated R&D spending. They do not, however, *prove* that the credits were stimulative, since some other factor might have caused the increase in R&D. But no other such factor is readily apparent.

The Baily-Lawrence-DRI study continues with a more sophisticated approach, based upon attempts to estimate the elasticity of demand for R&D spending. This analysis has one great advantage over the Nadiri study and other earlier efforts—it is able to use data pertaining to a period of time when the effective cost of R&D actually did change by a measurable amount, owing to the tax credit. The study tries several different specifications of an equation relating R&D spending to its cost (and other causal factors). The results indicate a price elasticity for R&D spending ranging between 0.2 and 1.0. (Again, an elasticity of 0.2 would mean that a 10 percent reduction in the price of R&D would result in a 2 percent increase in the quantity of R&D demanded.)

To estimate the effects of the actual tax credit, the study multiplies the estimated elasticities by the apparent reduction in the cost of R&D to the typical firm. As discussed earlier, this cost reduction is not the face value of 25 percent, but—owing to the effects on the base in later years—considerably less. Baily et al. estimate an average credit of 3 to 4 percent which, when multiplied by their estimated elasticity of between 0.3 and 1.0, yields an estimated increase in R&D spending due to the credit of 1 to 4 percent.

Results of Surveys of Firms

In 1984, Professor Edwin Mansfield, of the University of Pennsylvania, one of the leading authorities on the economics of technolog-

ical change, presented the results of a survey of 110 manufacturing firms. These firms were randomly selected and their expenditures on R&D comprised about 30 percent of all company-financed R&D in the United States. Interviews were carried out in person, by telephone, or by mail, and questionnaires were used. The response rate was high.

According to Mansfield, "The results indicate that the R&D tax credit has had only a modest effect on firms' R&D spending." Without the tax credit, it was reported, R&D expenditures would have been 0.4 percent lower in 1981, 1.0 percent lower in 1982, and 1.2 percent lower in 1983.

The sampling error was small enough to exclude large effects for the entire population of firms with a high degree of probability. The 95 percent confidence interval was 0.1 to 0.6 percent for 1981, 0.4 to 1.5 percent for 1982, and 0.6 to 1.8 percent for 1983. Mansfield concludes that "it is a very safe bet that the extra R&D stimulated by the tax credit has been considerably less than the revenue loss to the Treasury. . . . For 1983 . . . it is unlikely that the tax-credit induced R&D exceeded $638 million . . ." when the revenue loss by the Treasury was about $1 billion.

Clearly these results are inconsistent with the much larger effects presented in the previous sections of this paper. What could account for this difference?

1. The other results may be overestimated, as would be the case if some other, unmeasured, factor had produced the strong 1981–84 surge in R&D spending.

2. The survey participants may have systematically underestimated the effects of the tax credit. While there seems to be no reason why they would have done so deliberately, other factors must be considered: Were the people questioned in the position to speak authoritatively for the entire company? And for that matter, could *anyone* give an accurate estimate of so abstract a figure as was being sought? In other words, can we depend upon survey results to reveal what people (or their companies) really would have done if circumstances had been different?

3. Despite the care with which the sample was chosen, a few companies for which the credit was important might have been excluded, thus leading to an underestimate of the effects. According to the American Electronics Association et al. (1984, p. 30), "(Mansfield's) data on dollar increases in R&D spending for the computer and electrical and electronics industries are inconsistent with actual industry numbers. Thus, it appears likely that he missed some major R&D-intensive companies." Certainly, there were a number of high-tech executives who testified to the House Ways and Means Subcommittee on Oversight on August 3, 1984, that the credit was a significant stimulus.

4. The most likely reasons for the relatively low response shown in the survey results were the newness and the temporary nature of the credit. As will be discussed later, major R&D projects generally take a long time to plan and a long time to carry out. Even if firms started planning new R&D projects in mid-1981, when the credit went into effect, it would have been several years before these projects would have shown up in the spending figures. Also, the temporary nature of the credit would be expected to reduce its

stimulative effects on multiyear projects, which might be barely underway by the time of the credit's supposed demise at the end of 1985.

In other words, the Mansfield findings might well be correct, yet somewhat irrelevant to the future steady-state impact of the credit. The 3-year *increase* in the effects he observed—from 0.4 percent to 1.0 percent to 1.2 percent—are consistent with a gradual buildup in spending as research plans are gradually put into effect.

The U.S. General Accounting Office also performed a survey (1984). They reported that of the 86 firms in the GAO sample of firms that claimed the credit, 56 were encouraged by the credit to initiate new projects. While this finding appears somewhat more favorable to the credit's effectiveness than does the Mansfield study, it is difficult to draw any useful inferences from the results. We do not know how the sample was selected, and GAO did not attempt to project the findings to the universe of all firms. Furthermore, since no information was given on the dollar magnitude of the increase in R&D spending, the results are not directly comparable with those of the other analyses discussed in this paper.

Analysis of Tax Returns

Professor Robert Eisner of Northwestern University has concluded that ". . . the new incremental tax credit for R&D has a limited potential for stimulating expenditures. . . ." [2] This conclusion is drawn from Eisner's compilation and study of a considerable body of data—tax returns, annual reports, and various surveys—though it seems fair to say that the data are far from adequate and that Eisner's conclusion depends more heavily upon his theoretical analysis of the incentive features of the tax credit's formula.

Information from tax returns were provided by the Office of Tax Analysis (OTA) of the Treasury Department. The main shortcoming of the OTA data is that they extend only through 1981, the first year in which the credit applied, and then only for the second half. For reasons mentioned before, it seems unlikely that much could be learned from data so early in the life of the credit. Moreover, there is in these data very little by way of direct evidence on how much R&D was generated by the tax credit.

The closest that the Eisner work comes to this elusive question is when he compares rates of growth of R&D spending for firms which could use their entire credit to offset current tax liability, firms whose tax liability was positive but less than the value of the credit, and firms which had no tax liability. Eisner's hypothesis is that, if the credit was a stimulus, then firms with fully useable credit would increase their spending more than firms which could not use some or all of their credit.

Using OTA data for 1981, Eisner discovered no significant difference in growth of R&D spending between firms that were eligible for the credit and those that were not (Eisner, 1984 testimony, Table 1).

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[2] Testimony before the Oversight Subcommittee of the House Ways and Means Committee, Aug. 2, 1984.

Table 9 of his testimony, however, presents similar data from Compustat (which gets its data from firms' annual reports) for 1981, 1982, and 1983. For 1981, the data show little difference among the classes of firms; they are consistent with the OTA data. But for 1982 and 1983, firms with full or partial eligibility for the credit registered significantly greater increases in R&D spending than firms that were not eligible. This is consistent with the hypothesis that the credit stimulated R&D spending, though it provides no measure of how much R&D was generated.

It might be argued that the reason for the lesser use of the credit by ineligible firms was that these firms were experiencing low profit rates and hence could not afford to increase R&D. In other words, economic conditions, not the credit, explain variations in R&D spending. While this may be true, this argument implies that *no* data could possibly be consistent with the hypothesis of an effective R&D credit.

This is only a small part of Eisner's analysis. His overall evaluation of the credit's effectiveness is negative, based mainly on characteristics of the formula that will be discussed in the next chapter.

V. COST EFFECTIVENESS AND THE CREDIT'S FORMULA

Many of the criticisms of the tax credit for R&D have to do with the formula by which the credit is calculated. The most serious of these criticisms are related to cost effectiveness. The purpose of this chapter is to examine these criticisms and to see whether improvements are feasible.

Concepts of Cost Effectiveness

What is the proper measure of cost effectiveness for a tax credit? As a first approximation, let us consider a kind of benefit-cost ratio; namely, the ratio of *additional R&D* induced by the credit to the cost in *revenue foregone* by the Treasury. This is implicitly the measure used by Mansfield in his testimony. This approach appeals to one's common sense, in that it is the ratio of what the program is supposed to achieve to what the program costs.

In order to be effective, according to this definition, it would appear that the elasticity of demand for R&D would have to be greater than one. If the elasticity is below one, then a dollar of tax revenues foregone would yield less than a dollar of additional R&D. This would be true regardless of how generous the tax credit was; it could be 25 percent of additional R&D, or it could be 5 percent of all R&D. In either case, benefits would be less than costs. And since most of the empirical studies of the demand for R&D—rough though they may be—conclude that the elasticity of demand for R&D is less than one, then it would seem that the case for the credit is very difficult to make.

If, however, it is conceded that the societal benefits of R&D exceed its dollar cost, then those additional benefits must be added into the calculations. For example, if a dollar's worth of R&D is valued by society at $1.30, and if a dollar's worth of tax credit induces only $0.80 worth of R&D, the credit is still cost effective. That is, the costs are $1, and the benefits are $1.04 ($0.80 multiplied by 1.3). This is the approach taken by Baily et al. (1985).

Another concept of cost effectiveness would reject the benefit-cost framework altogether and argue thus: Given that we want to enact a slight tax cut, should we reduce rates across-the-board or should we encourage R&D by confining that reduction to a tax credit for R&D? In 1981, it was decided to cut taxes. The accelerated depreciation provisions provided very little benefit for high-technology companies because the speedup in depreciation applied only to long-lived equipment. Therefore, to make the tax cut more neutral, it was decided to enact the R&D tax credit as part of the overall tax reduction package. This is the argument presented by Paul Oosterhuis in Brown (1984), pages 21 and 22.

This argument is certainly logical. It is, however, next to impossible to keep tabs on the "neutrality" of tax reform. Numerous in-

dustries and interests could legitimately claim tax credits as their due in compensation for the even greater benefits received by others.

Another reason to question the cost-effectiveness approach is that it has not been applied with any severity to the host of other tax expenditures in the Tax Code and, failing that, there is no reason to single out R&D as the subject for close scrutiny.

Still, it is worthwhile to consider this type of cost effectiveness, especially in evaluating proposals for changing the credit's formula.

Problems With the Incentive Mechanism

No feature of the tax credit has come under more criticism than its peculiar manner of figuring the amount of the credit that firms would receive. As indicated earlier, the tax credit for a given year equals 25 percent of the difference between that year's qualified R&D spending and the firm's "base." The base is defined to be the average of the firm's R&D spending for the previous 3 years.

The main problem is that this formula offers less of an incentive than would some reasonable alternatives. Furthermore, under some circumstances, the formula creates a method of encouraging R&D which is decidedly non-cost effective, at least under conventional measures of cost effectiveness.

We have already mentioned (Chapter III) why the moving base reduces the incentive from the nominal 25 percent to the neighborhood of 4 to 6 percent. This is because an increase in R&D spending of $1, while earning a credit of 25 cents reduces the potential credit in the next 3 years as much as 25 cents. Note that the problem is not that the base changes, but that the firm's own actions can change its base. As we shall see, the way around this problem would be to make the base independent of the firm's actions.

The first reason why this formula is faulty is that it reduces the cost effectiveness of the credit. But what is the proper measure of cost effectiveness? Consider the rough benefit-cost ratio discussed earlier, the ratio of *additional R&D* (induced by the credit) to the cost in *revenue foregone* by the Treasury.

The amount of additional R&D that a firm funds (the numerator of the cost-effectiveness ratio) depends upon the effective discount on the cost of R&D and the price elasticity of demand for R&D. That the effective discount turns out to be only 6 percent would, at first glance, seem to be no problem for cost effectiveness. If the credit is only 6 percent in the numerator of the cost-effectiveness measure, then so too is the cost to the Treasury (in the denominator). The "bang" is less, but the "bang for the buck" would be the same.

But this is not the case. All of the additional R&D that the firm would have funded without the added stimulus of the credit receives a 25 percent tax credit, and this amount also goes in the denominator as part of the cost. In fact, the more rapid the growth of the firm's R&D budget (apart from the spending induced by the credit), the more of a tax credit the firm receives and the lower is this measure of cost effectiveness. In other words, firms with fast

growing R&D budgets receive large tax credits, and this cost to the Treasury dilutes the measured cost effectiveness.

Another problem with the formula is that under some circumstances it might induce a firm to decrease its R&D budget in the short run. This would occur if the firm's planned R&D was below base, so no credit was forthcoming during the current period. By reducing its R&D further, the firm would be reducing its base in future years, making it easier to earn credits during those years. This "cycling" phenomenon was recognized by Eisner, but also by analysts of other subsidy schemes with analogous formulas. Whether this would be of any practical significance is questionable because it is doubtful that firms would want to juggle more than a small part of their R&D budget for short-term tax gains.

R&D spending is, by and large, subject to long-term planning. While a firm might be tempted to cut down on peripheral research spending, or postpone some equipment purchases, it is doubtful that a firm would disrupt the continuity of its major programs just for a chance at higher credits later. And this would, indeed, be only a chance at later credits, for the firm could not predict with certainty that it would in fact earn a usable credit in future years.

Still another related problem is with the procyclical nature of the credit in the aggregate. When private R&D is booming, then most firms are eligible for the credit. During economy-wide slumps, however, when many firms drop below base and are not able to qualify for the credit, the tax credit's aggregate stimulative power would drop. Some of the motivation for enacting the credit stemmed from Congress's concern with the R&D slump of the 1970's. Should such conditions recur, the incremental credit would not be a very powerful stimulus. In other words, when R&D is racing ahead, the R&D credit gives it a shot of adrenaline; when R&D slows, the credit becomes something of a sedative.

Problems With the Definition of R&D

It is perhaps impossible to give "research and development" an airtight definition. When firms account for their R&D spending, they will inevitably have some leeway. Being eligible for a tax credit, they have an incentive to define as R&D as many of their activities as possible. As a result, the tax credit has been criticized by those who contend that a significant portion of R&D claimed on tax returns is at best inaccurate and at worst fraudulent. If true, this would erode the cost effectiveness of the credit, since the Treasury would be paying for fictitious, not actual, R&D.

It is not the purpose of this paper to propose a better definition of R&D, nor to judge the extent to which firms have overstated their R&D spending. But several observations should be made in order to keep this problem in its proper perspective.

There is some evidence that overstatement of R&D was a problem in the first year or two of the credit's existence. As Eisner points out, data from a sample of tax returns showed a 42.7 percent increase in R&D spending in 1981 over 1980, a far larger increase than was shown by National Science Foundation data (17.0 percent) and Compustat data (14.9 percent). In other words, firms may have reported larger increases in R&D on their tax forms, when it

was worth money to them, than on independent surveys, when the results were of no financial consequence.

From this standpoint of cost effectiveness, however, exaggeration of R&D costs is less a problem than might be thought initially. First, the definition of R&D can be tightened, and indeed it has in the current versions of the R&D tax credit bills introduced before the House and the Senate in 1985.

Second, the incremental nature of the credit makes it essentially self-correcting. If a firm overstates its R&D costs in year one, it not only increases its year-one credit, it also increases its base for the next 3 years, thereby reducing its potential credits during those years. Just as the peculiar shifting base lowers the incentive to fund R&D, it lowers the rewards for overstating R&D.

Basically, a firm cannot significantly inflate its tax credit more than once. If, in the first year, it inflates its R&D by 20 percent, it will have increased its tax credit by one-fourth of that amount. But it would have to maintain that same 20 percent fudge factor in all succeeding years just to stay even. Only by artificially inflating its R&D spending, at an exponentially growing rate, could it continue to inflate its tax credits by a fixed amount each year. Since this is extremely implausible, we can conclude that persistent cheating is not feasible.

Further, it can be said that most of the costs of cheating have already been incurred, except for firms now claiming credits for the first time. If, however, the credit were terminated and then resumed with a new calculation of the base, the initial costs of cheating would have to be borne all over again.

This self-policing mechanism has received little attention from critics of the incremental formula. Yet it is an extremely valuable feature from the standpoint of cost effectiveness. Furthermore, it is a feature that would be lost under some alternative formulas, such as a straight, nonincremental credit equal to a certain percentage of R&D. Any effort to revise the formula must recognize the value of this feature.

Possible Modifications

Several suggestions for change have been made by Eisner and others. The basic idea is to break the link between a firm's current R&D spending and its future eligibility for credits. Several options exist:

1. Make the credit a fixed percent of all R&D. This would not solve the problem. To get a credit of equivalent total cost to the Treasury, the rate of credit would have to be only about 5 percent. Then the marginal incentive would be about what it is now. The only major change would be a significant redistribution of credits from firms with fast-growing R&D budgets to firms with a slow R&D growth.

2. Make the company-specific base equal to the average of R&D spending in 1983, 1984, and 1985, but let this base grow by some rate that is unrelated to the company's R&D spending in post-1985 years. This growth rate could be the industry-wide growth of R&D spending, or it could be an inflation factor such as the GNP deflator.

In considering these options, however, it must be recognized that there may be no perfect formula; every alternative, of which I am aware, has some defect. For example, using as the base the average of the last 3 years of spending for the industry as a whole would indeed weaken the link between a firm's spending and its base, but at the cost of administrative complications. How, for example, would one assign diversified firms to particular industries? Such assignment would mean millions of dollars of potential change in the firms' tax liabilities and might be hotly contested. If, instead, one simply indexes the firm's historical base, there is the danger that the index will make the base grow too fast (thereby canceling the credit) or too slowly (thereby inflating the cost to the Government and eventually eliminating the incremental nature of the credit).

Any change in the formula would inevitably benefit some firms and harm others. For example, using an industry-wide base would be advantageous to firms that spend more on research (in proportion to their size) than other firms in the industry. While there is no objection to this on cost-effectiveness grounds, it might cause political obstacles to change.

Finally, the self-policing characteristic of the formula could be lost in some variations.

To date, there have been no well-analyzed alternate formulas seriously proposed. In the absence of such analysis, it might be preferable to keep the current incremental mechanism rather than adopt a new formula with unsuspected pitfalls.

Limited Applicability of the Credit

Several restrictions limit firms' access to the credit. Whether these restrictions are truly faults, or simply are necessary limitations, depends upon whether they interfere with the main objective of the credit, which is to increase the amount of socially productive R&D by cost-effective means.

1. Firms whose R&D increase by more than 100 percent of their base get a marginal tax credit of only 12.5 percent rather than the full 25 percent. This results from the provision that for such firms with extraordinarily fast-growing R&D budgets, the base becomes 50 percent of actual expenditures. An additional dollar of R&D, in these circumstances, increases the base by 50 cents and, therefore, increases the excess over base by only 50 cents. The 25 percent credit applied to the 50 cents gives a credit of only 12.5 cents, or 12.5 percent of the additional dollar of R&D.

The reason for this restriction apparently was to prevent firms from receiving large credits when they increased their R&D spending very rapidly. There would seem to be no reason to do this, other than by some standard of modified egalitarianism. But with reference to the basic reason for the credit—to increase private R&D spending—this restriction is unjustified, since R&D performed by a fast-growing firm would seem to have worth at least equal to that of R&D funded by other slower growing firms.

As Eisner points out, firms in this category might have some incentive to reduce their current R&D spending, saving it for a later

year when it might be worth a full 25 percent credit. Therefore, this restriction interferes with the intended results of the credit.

Empirically, this limitation is of relatively slight importance. According to the American Electronics Association et al. (1984, p. 43), only 30 of the 800 firms in the Business Week survey achieved 1983 R&D levels which were estimated to exceed 100 percent of base period levels. Since these were all small companies, their R&D funding in excess of 100 percent above base was estimated to be only $70 million. This was less than 0.2 percent of R&D spending for the Business Week sample. It would be surprising if this limitation had reduced total R&D spending by more than a few million dollars.

Eisner's analysis implies a larger, but still relatively small portion of total R&D was subject to this limitation.

While of minor quantitative significance, this limitation deserves to be considered for elimination. It reduces the incentives for some small, fast-growing companies, which may well be performing some of the most productive research. The additional cost to the Treasury would be small—perhaps around $10 million.

2. Firms with no tax liability receive no (or significantly reduced) credits. This is of some quantitative importance; Eisner estimated that in 1982 at least 32 percent of the potential credit could not be used because the firms had no tax liability against which to offset the credit. (This correlation between the credit and the business cycle is another issue, discussed earlier in this study.) The force of this criticism is reduced by the fact that the credit has both a 3-year carryback and a 15-year carryforward.

This feature—that a firm must have tax liabilities before a credit is of any value—is characteristic of all tax credits. The alternative would be to make the credit fully refundable; i.e., a straight subsidy. This would increase the cost considerably. It is therefore not an option likely to win much support in Congress, nor is it favored by high-tech industry groups, for whom this feature is of little importance.

One possibility for modification, however, would be to make the credit available to startup companies, which necessarily have no tax liability. The argument is that such companies are particularly fertile sources of innovation (much more so than the entire group of firms with no tax liability) and, therefore, should be given eased eligibility. The House and Senate bills introduced in the 99th Congress contain provisions extending the credit to startup companies.

3. Firms with spending below base receive no credit. One might object to this limitation for two reasons. First, all firms might be deemed to "deserve" the credit. This egalitarian argument is, however, incompatible with the whole notion of providing incentives, for if you get a credit no matter what you do then there is no incentive for you to change your behavior.

Second, a more serious objection to this feature is that firms below base might perceive it to be in their interests to reduce their R&D spending further, thus lowering their base in future years and making it easier to earn tax credits later. This objection is, in my view, correct in principle, but there is no clear evidence on how important a factor it might be, as was discussed on page 18. Elimi-

nating this problem would entail modifying the formula to make the base independent of current R&D spending.

In summary, the only limitations that are truly flaws could be eliminated by making the credit available to startup companies and by eliminating the 100 percent of base limitation. Neither action would have major consequences for revenues.

VI. BROADER ISSUES IN THE RELATION BETWEEN R&D AND THE TAX SYSTEM

The discussion thus far has been focused on the cost effectiveness of the tax credit for R&D, somewhat in isolation from other important issues in taxation. But this wider context is important.

Too Many Credits and Deductions?

In his August 2, 1984, testimony before the House Subcommittee on Oversight (Committee on Ways and Means), Rudolph G. Penner, Director of the Congressional Budget Office, posed the problem as follows:

> Thus far, Mr. Chairman, my comments have not considered how the R&D tax credit has complicated the Tax Code. In general, the more the tax system is burdened with credits and special exemptions, the less effective each credit or incentive becomes. This is certainly so when companies have so many credits and deductions available that they can completely cancel out their current and future tax liabilities. At that point, tax incentives are no longer effective. In 1981, half of all corporations had no tax liabilities. We have reached the point that our tax system is asked to do so much that it does nothing very well. That includes its fundamental purpose: raising revenues.
>
> The economic incentive of each new credit (or special deduction) is also reduced as other economic activities are offered preferred tax treatment. For example, the availability of the ITC tends to dilute the effect of the R&D credit by making investment in capital equipment comparatively more attractive than if no credit were allowed. As more economic activities are given special treatment, each activity loses its comparative advantage, thereby negating the effects of any one incentive. Furthermore, the proliferation of tax credits, as well as uncertainty about their status, makes the Tax Code more cumbersome, complicates the investment planning of firms, and can raise the public's perception that the tax system is unfair.

This statement raises a number of issues. First of all, Mr. Penner warns against the general proliferation of tax credits, resulting in a Tax Code which is inefficient, cumbersome, and does not perform its primary task of raising revenues. Second, since the Tax Code is already so watered down, these remarks are also a warning that the R&D tax credit may be less of an incentive than hoped for. Third, the testimony implicitly suggests the merit of revising the Tax Code to make it simpler and more efficient.

There is no question that the corporate tax is diminishing relative to other taxes. In 1960, 22.3 percent of Federal receipts came from the corporate profits tax; while in 1984, the figure was only 9.9 percent. Corporate taxes, as a percentage of gross national product, fell from 4.2 percent in 1960 to 1.9 percent in 1984. As these percentages fall with time, there are likely to be more and more firms without tax liabilities and, hence, more firms for which the R&D tax credit is no incentive. (This relates to two points discussed earlier: the question of whether the credit should be refundable, and the likelihood that during a recession the effectiveness of the credit would diminish significantly.) Nevertheless, with an estimated revenue loss of $1.6 billion for 1985, it would seem that the R&D

tax credit is still of some importance to the overall tax liability of corporations.

The Need for a Stable Tax Environment

Research and development activities by corporations are long-term ventures. Adding up the time needed for various phases—experimentation, testing, and development for commercial success—the time horizon is at least 3 years and sometimes as long as 10 years. Rational analysis of the financial aspects of an R&D project would need to consider tax credit eligibility for several years in advance. If the tax treatment of R&D changes unpredictably, then tax benefits would become a lesser factor in the planning process.

The existing credit's expiration date of December 31, 1985, has been looming ever nearer for firms planning their R&D. One would surmise that the tax credit is not now a major consideration in a company's planning, except to the extent that the company (1) can advance its spending plans for projects that it had definitely decided to undertake, and (2) wishes to prognosticate the willingness of Congress to extend the credit. Therefore, it is safe to say that the credit is losing whatever effectiveness it had earlier.

Such inconstancy of tax provisions is not uncommon, of course. The recent history of tax policy is one of instability. The investment tax credit has been canceled and reinstated. It was made "permanent" only to be written out of the President's 1985 tax proposals. Rules for depreciation have been changed frequently. Various credits and deductions—many of great importance—have gradually built up and now face extinction if tax reform proceeds. Effective rates on capital gains have been raised and lowered many times.

Clearly our tax system is overly complex, with tax rates that are too high by virtue of being overly generous with deductions, credits, and exclusions. If one could be sure that a simpler system with lower rates would be enacted and then left alone for 20 years, tax reform would be far more attractive. But if the reformed Tax Code faces the same fate of perennial revisions that have churned the tax system for decades, then tax reform holds less appeal.

While a completely stable tax environment is probably unobtainable, given political realities, we must press for stability wherever it is feasible. With the R&D credit, this can be done by legislating permanence. And if the tax credit survives reform and takes its place among the thinned ranks of tax credits in a new, streamlined Tax Code, this may give firms more confidence that it will not go the way of their 1981 ACRS depreciation schedules.

The R&D Tax Credit in a Simplified Tax Code

It has been argued that if a simplified tax system is established—for example, the Kemp-Kasten or Bradley-Gephardt bills—the firms would not "need" the tax credit.

But it is not so much that *firms* need the tax credit as that the rest of *society* needs it. The object of the tax credit was to induce firms to spend more on R&D than they otherwise would because it was recognized that social benefits, over and above those benefits that go to the firm, result from R&D. A simplified Tax Code with

lower rates has much to recommend it, but such a Tax Code would not necessarily promote the optimal amount of R&D spending. The cost of an extra dollar of R&D is clearly less under the current Tax Code with a credit than it would be under any of the leading reform plans without the credit.

Would a simplified Tax Code stimulate spending on R&D? In principal, tax reform could generate more R&D by means of "income effects" or "demand effects." That is, it is theoretically possible that a reformed tax plan could leave firms with so much more money after taxes that they would increase their spending on R&D by an amount greater than what the R&D tax credit has induced. But given that firms spend only about 5 percent of their revenues on R&D, it would take a tax cut far in excess of any contemplated to increase R&D by even $2 billion. It also might be argued that tax reform would give such a boost to the economy that the demand for high-tech goods would spur R&D. High-tech goods that are produced in this country are mostly producer goods—machinery and equipment used by firms to produce other goods. (Relatively little of our high-tech production is bought by consumers, thanks to imports from the Far East.) When firms invest in new equipment, they naturally tend to buy the latest technologies. Therefore, the demand for high-tech goods is closely related to the rate of business investment. If tax reform spurs investment, then it will stimulate R&D.

But two reservations should be mentioned. There is controversy over some of the tax plans as to whether investment would actually be stimulated at all. For example, Michael Boskin (1985) says that the President's tax proposal of May 1985 would significantly reduce capital formation. Certainly none of the tax plans promised such an investment bonanza as to make R&D rise rapidly as a consequence. Second, it must be repeated that the argument for the credit is that it stimulates R&D spending over and above what firms would spend on their own, regardless of what level that is. Even if R&D spending were to pick up as a result of improved economic conditions, this would not eliminate the desirability of further stimulus.

VII. CONCLUSIONS AND POLICY CONSIDERATIONS

This study has reviewed three aspects of the R&D tax credit which pertain to the desirability of its continuation:

Its basic justification,

Whether it has stimulated spending on R&D, and

Whether it is cost effective.

The basic justification for favorable tax treatment is that research and development is vital to economic growth but the private sector on its own would spend less than an optimal amount on R&D. This justification is widely accepted and well supported by analysis.

Empirical evidence on whether the tax credit has stimulated R&D spending tends to support the position of those who advocate continuing the credit. On one hand, trends in R&D spending are consistent with the hypothesis that the credit has been stimulative. On the other hand, data suggesting that the credit has not worked are not persuasive, particularly since the relevant data were collected too early in the credit's existence to be fully relevant to the present situation.

Because of the weakness in empirical evidence, arguments on the cost effectiveness of the credit rest mainly on theoretical arguments. Of these, the most important is that related to the "shifting base"; i.e., the contention that the nominal 25 percent credit is in reality only about a 6 percent discount on incremental R&D when effects on future credits are considered. This is indeed a problem, but one that might be correctable.

Throughout this discussion, it is vital to distinguish between the very different questions:

Was the tax credit cost effective back in 1981, 1982, and 1983?

Would a tax credit be cost effective in 1986 and later years?

While the first question is of some interest, it does not automatically answer the second. In fact, my view is that the answer to the first question is "Just barely, but it's hard to say," while the answer to the second is "Very likely yes."

The reason for this difference is that in the early years firms had not fully adjusted to the availability of the credit. They could not immediately increase their R&D spending levels to the new, higher levels which the credit had established. Second, not knowing whether the credit would be made permanent, firms did not treat it as a certain source of tax savings far into the future; this too reduced the credit's impact. A permanent credit would overcome both of these barriers to effectiveness.

Policy Considerations

1. Should the tax credit be continued? All things considered, the tax credit for R&D appears to be a reasonable way to encourage private-sector funding of R&D. This conclusion is equally applicable in the context of the current Tax Code and in the tax reform plans now being debated. Only in the context of radical tax simplification, such as the Hall-Rabushka plan, would the tax credit perhaps be superfluous.

2. If continued, should it be made permanent or merely extended? As has been argued throughout this study, the long-term nature of research and development is at odds with a temporary credit. A permanent credit would give a greater stimulus to R&D funding and would, therefore, be more cost effective. The argument that a temporary credit would give us more time to collect evidence is spurious. Such evidence would be hard to gather, as we have seen throughout this study. Moreover, it would obviously apply only to a temporary credit, not to a permanent one.

3. Is the definition of research and development satisfactory? It appears that the Tax Code could legitimately be modified to make the operational definition of "research and experimentation" more specific and to exclude borderline activities that do not deserve to be subsidized. The revised definition given in H.R. 1188 and S. 58 appear to tighten the definition satisfactorily.

4. Should the formula be changed? The most beneficial change would be to make the base independent of a firm's own spending on R&D. But devising a new formula is tricky because, as was discussed earlier, new problems can spring up. In the absence of any well-analyzed alternative formula, it might be preferable to keep the existing incremental mechanism rather than to chance a new formula with unforeseen pitfalls.

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